PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:
C03B 7/12	A1	WO 92/16464
		(43) International Publication Date: 1 October 1992 (01.10.92)

(21) International Application Number: PCT/SE91/00196

(22) International Filing Date: 15 March 1991 (15.03.91)

(71) Applicant *(for all designated States except US)*: AGA AKTIEBOLAG [SE/SE]; S-181 81 Lidingö (SE).

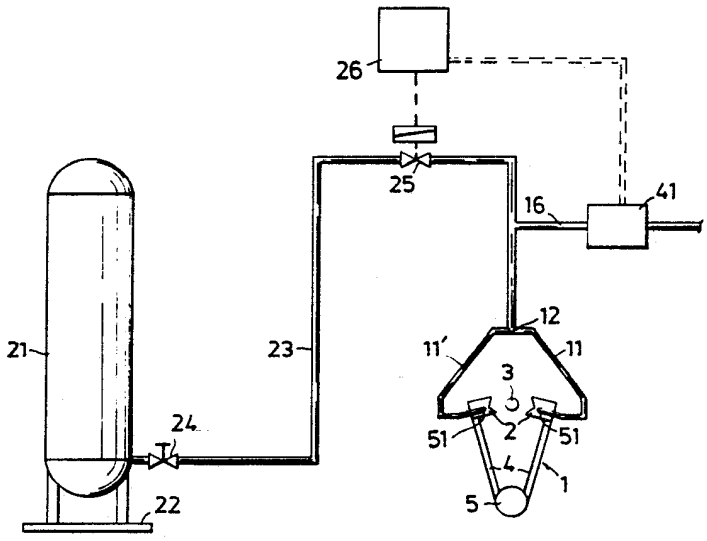
(72) Inventor; and
(75) Inventor/Applicant *(for US only)* : BALDUHN, Reinhard [DE/DE]; Tegelhof 1, D-3490 Bad Driburg (DE).

(74) Agent: WIEDEMANN, Bernd; Aga Aktiebolag, S-181 81 Lidingö (SE).

(81) Designated States: AT (European patent), BE (European patent), BR, CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FI, FR (European patent), GB (European patent), GR (European patent), HU, IT (European patent), JP, LU (European patent), NL (European patent), NO, PL, SE (European patent), US.

Published
With international search report.

(54) Title: METHOD FOR COOLING AND LUBRICATING OF TOOLS FOR CUTTING OF MOLTEN GLASS



(57) Abstract

The present invention relates to a method of cooling and lubrication working areas of tools for mechanical working using liquid carbon dioxide. The method comprises the steps of passing liquid carbon dioxide from a source of liquid carbon dioxide through a conduit and a nozzle, applying the carbon dioxide on and/or near the working area of the tool and/or on the worked goods, the lubricant being soluble or dispersible in liquid carbon dioxide is added to the liquid carbon dioxide before it enters the nozzle. The lubricant is added to the liquid carbon dioxide leaving the nozzle in an amount less than 5.0 per cent by weight, preferably in an amount of 0.5-2.5 per cent by weight.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria
AU	Australia
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CS	Czechoslovakia
DE	Germany
DK	Denmark
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IT	Italy
JP	Japan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
LI	Liechtenstein
LK	Sri Lanka
LU	Luxembourg
MC	Monaco
MG	Madagascar
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
NL	Netherlands
NO	Norway
PL	Poland
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SN	Senegal
SU	Soviet Union
TD	Chad
TG	Togo
US	United States of America

METHOD FOR COOLING AND LUBRICATING OF TOOLS FOR CUTTING OF MOLTEN GLASS

The present invention is concerned with a method of cooling and lubrication working areas of tools for mechanical working using liquid carbon dioxide. The method comprises passing liquid carbon dioxide from a source of liquid carbon dioxide through a conduit and a nozzle, and applying the carbon dioxide on and/or near the working area of the tool and/or on the worked goods.

Mechanical working, e.g. lathing, cutting, grinding and polishing, of metallic materials is always accompanied by the generation of heat. Therefore a cooling medium is applied to the area of such mechanical working, thus cooling both the tool and the worked piece. One such cooling medium is a cutting coolant, usually a emulsion of water and oil. Such emulsions will give environmental problems for disposal and will contaminating the workers' area. Another coolant is carbon dioxide which is passed through a conduit as a liquid under pressure and exits through a nozzle. Due to the pressure drop upon leaving the nozzle the carbon dioxide is transformed to solid carbon dioxide having good cooling efficiency and some lubricating effect.

Another application for using liquid carbon dioxide as a coolant is the cooling of scissors cutting strings of liquid glass for the manufacture of glass articles. Such application is disclosed in WO 90/03341 describing a method for cooling a cutting element of shears used to sever a glass gob from a continuous string of liquid glass. The method comprises cooling the cutting elements of the shears with a cryogenic liquid, i.a. carbon dioxide, and applying the cryogenic liquid to cutting element surfaces which come into contact with the liquid glass string.

However, the use of a cryogenic liquid for cooling will not provide for sufficient lubrication. Thus, it is necessary to apply a lubricant separately to the areas where heat is generated during the mechanical working. Such a separate application may cause some problems due to space requirements and difficulties in the distribution, e.g. the mixing and dosing at the cooling site, of the two media to the working

areas.

The main object of the present invention is to avoid the use of two different supply streams to the working area when using a cryogenic liquid for cooling.

Another object is to apply one jet of the cooling medium to the working area containing a well defined concentration of lubricant in the cryogenic liquid, thus keeping the amount of lubricant as low as possible.

These objects are solved in that cooling and lubrication working areas of tools for mechanical working is performed by using liquid carbon dioxide and comprising the steps of passing liquid carbon dioxide from a source of liquid carbon dioxide through a conduit and a nozzle, applying the carbon dioxide leaving the nozzle on and/or near the working area of the tool and/or on the worked goods, the lubricant being soluble or dispersible in liquid carbon dioxide and added to the liquid carbon dioxide before it enters the nozzle. Preferred embodiments are defined in the dependent claims.

The present invention will now be described in more detail with reference to non-limiting exemplifying embodiments thereof illustrated in the accompanying drawings.

Figure 1 illustrates schematically an arrangement of apparatus for carrying out the inventive method.

The arrangement illustrated in Figure 1 includes shears 1 having two legs 4 which can be swung towards and away from one another about a pivot axis 5, which extends perpendicular to plane 5, each leg has mounted thereon a cutting element 2 for cutting a glass gob or drop from a string of liquid glass mass 3.

The liquid glass string is taken from a glass forehearth located above the shears. The glass mass leaves the furnace in the form of a vertical string which travels at a well defined oscillating speed and which passes through an orifice (not shown) located at a short distance above the shears 1. The glass gob separated from the string is transported gravitationally along a chute, to a mold located in the forming machine (not shown).

The Figure 1 arrangement also includes a storage tank 21

for liquid carbon dioxide. The tank 21 rests on a stand or base 22. Extending from the tank 21 is a conduit 23 which branches out into two branch conduits 11 and 11' at a point downstream of an electromagnetic valve 25. The branch point is referenced 12. The end of each branch conduit 11, 11' distal from the branch point 12 is connected with a nozzle 51 which is firmly attached to a respective cutting element 2. The nozzle 51 is directed towards its associated cutting element, and particularly towards the cutting surface thereof. The conduits 23, 11 and 11' are preferably as short as possible, so as to avoid or at least minimize vaporization of liquid in the conduits to an undesirable gas phase. The conduits are preferably vacuum conduits. The vacuum conduits may incorporate joints which will enable them to be bent or twisted.

A conduit 16 is opening into conduit 23 downstream of the electromagnetic valve 25 for the addition of a lubricant being soluble or dispersable in the liquid carbon dioxide. The lubricant is forced into the carbon dioxide by a metering pump 41 being connected to a source of lubricant (not shown). The pump 41 is activated to deliver lubricant when carbon dioxide is flowing through pipe 23. A suitable lubricant is CRUCOLAN 7, which is marketed by Klüber Lubrication München KG, Germany, being soluble in liquid carbon dioxide. The lubricant may be cooled to a low temperature before being injected in pipe 23 in order not to evaporate the liquid carbon dioxide.

When initiating cooling of the shears 1 with liquid carbon dioxide the valves 24 and 25 are opened. When these valves are open, carbon dioxide is forced by the pressure in the tank 21 through conduit 23. As liquid carbon dioxide passes through valve 25 the metering pump 41 is activated to inject lubricant into conduit 23. The carbon dioxide will exit the conduit 23 through the nozzles 51. Due to the pressure drop when leaving the nozzles the liquid carbon dioxide will be transformed to solid carbon dioxide. The nozzles are directed, so as to cool and lubricate the cutting areas of the shear blades 2 as effectively as possible.

Subsequent to commencing cooling of the shears 1, a string of liquid glass can be taken from the forehearth and passed vertically through the orifice located above the shears 2, so as to initiate the cutting of glass gobs from the string. The cutting elements mutually coact in cutting gobs from the string, in a manner similar to the blades of conventional scissors.

The amount of lubricant added to the liquid carbon dioxide should not exceed 5 per cent by weight. A preferable range of lubricant concentration in the carbon dioxide is 0.5 to 2.5 per cent.

The carbon dioxide containing lubricant can be directed to the shears continuously or intermittently. In one embodiment lubricant is added intermittently to the liquid carbon dioxide immediately upstream the nozzle in such periods that the carbon dioxide leaving the nozzle will contain no lubricant when the scissors are in contact with the string of molten glass. In this embodiment the carbon dioxide is continuously cooling the shears.

In another embodiment the nozzles can be positioned at a certain distance from the glass string and directing their jets in such a direction that the scissors are intermittently contacted by the carbon dioxide when retracted from the glass string.

In a further embodiment a pressure tank can be located between the valve 25 and the branch point 12. In such case the conduit 23 between the valves 24 and 25 need not to be a vacuum pipe, since gaseous carbon dioxide can be removed from the pressure tank. In this embodiment the lubricant may also be added to the pressure tank, but this is a less preferred embodiment. In the preferred embodiment the lubricant is added downstream of the pressure tank.

In case of cooling and lubrication working areas of tools for mechanical working the same arrangement as shown in Figure 1 can be used. The only difference is that the shears are substituted by a mechanical working machine, such as a lathe, and that the conduits are not fixed to the blades 2. The nozzles 51 may be positioned on the slide on which the

cutting tool is fixed and are directed against the tool, preferably the area contacting the goods to be worked on and/or the working area of the goods. In this case the nozzles are provided at a constant distance from the areas to be cooled.

CLAIMS

1. A method of cooling and lubrication working areas of tools for mechanical working using liquid carbon dioxide comprising the steps of passing liquid carbon dioxide from a source of liquid carbon dioxide through a conduit and a nozzle, applying the carbon dioxide on and/or near the working area of the tool and/or on the worked goods, characterized in that a lubricant being soluble or dispersible in liquid carbon dioxide is added to the liquid carbon dioxide before it enters the nozzle.

2. The method according to claim 1, characterized in that the lubricant is added to the carbon dioxide in the conduit.

3. The method according to claim 1 or 2, characterized in that the carbon dioxide leaving the nozzle contains less than 5.0 per cent by weight of the lubricant.

4. The method according to claim 3, characterized in that the carbon dioxide contains 0.5-2.5 per cent by weight of the lubricant.

5. The method according to one or more of claims 1-4, characterized in that the lubricant is injected in the carbon dioxide only when carbon dioxide passes through the nozzle.

6. The method according to one or more of claims 1-5, characterized in that the carbon dioxide is applied to mechanical scissors for cutting strings of liquid glass.

7. The method according to claim 6, characterized in that the carbon dioxide is applied to the scissors when the scissors are not in contact with the string of liquid glass.

8. The method according to claim 6, characterized in that the carbon dioxide is applied continuously to the scissors and that the lubricant is added to the carbon dioxide intermittently such that pure carbon dioxide will cool the scissors when the scissors are in contact with the string of liquid glass and lubricant containing carbon oxide will cool the scissors when these are not in contact with the string.

9. The method according to claim 1 or 2, characterized in that the carbon dioxide is continuously supplied to the cooling areas.

10. The method according to claim 1 or 2, characterized in

that the carbon dioxide is intermittently supplied to the cooling areas.

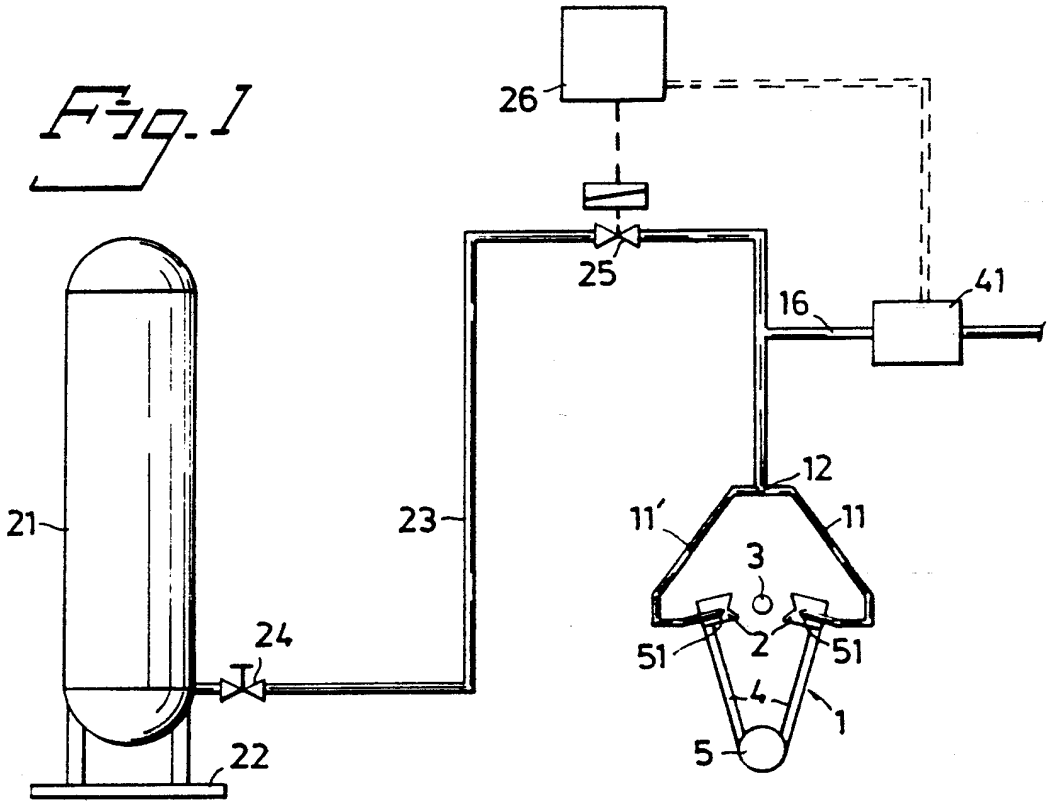
11. The method according to claim 1 or 2, characterized in that the lubricant is continuously added to the carbon dioxide.

12. The method according to claim 1 or 2, characterized in that the lubricant is intermittently added to the carbon dioxide.

13. The method according to claim 1 or 2, characterized in that the carbon dioxide is supplied to the working area from the nozzle located at a fixed distance from the cooling area.

14. The method according to claim 1 or 2, characterized in that the carbon dioxide is supplied to the working area of the tool from a fixed nozzle position and that the tool is intermittently brought into contact with the carbon dioxide from the nozzle.

Fig. 1



INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 91/00196

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: C 03 B 7/12

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	C 03 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
Y	WO, A1, 9003341 (AGA AB) 5 April 1990, see page 6, line 4 - line 21; figures 1,2; claims 1-6,10 --	1,6,11, 13
Y	US, A, 4475938 (KNOTH) 9 October 1984, see column 3, line 59 - column 4, line 3; figures 5,6 --	1,6,11, 13
A	EP, A1, 0035145 (HERMANN HEYE) 9 September 1981, see figure 1; claim 1 --	1
A	US, A, 3287098 (W.A. STUTSKE ET AL) 22 November 1966, see figures 1,4; claims 1-3 --	1,14

----

* Special categories of cited documents:[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
15th October 1991	1991 -10- 21
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Petter Sörsdahl

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.PCT/SE 91/00196

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on 91-08-30
The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO-A1- 9003341	90-04-05	EP-A-	0329634	89-08-23
		EP-A-	0435866	91-07-10
US-A- 4475938	84-10-09	DE-A-C-	3113303	82-10-14
		EP-A-	0062146	82-10-13
		WO-A-	82/03384	82-10-14
EP-A1- 0035145	81-09-09	AT-E-	6929	84-04-15
		DE-B-C-	3007512	81-07-16
		JP-C-	1342481	86-10-14
		JP-A-	56120536	81-09-21
		JP-B-	61006017	86-02-22
		US-A-	4391620	83-07-05
US-A- 3287098	66-11-22	NONE		